Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs

National Research Council

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Statement of Task

An ad hoc committee of the standing Committee on Animal Nutrition will be appointed to conduct a review of the scientific basis for estimating air emissions from concentrated animal feeding and production systems in the United States. The committee will review and evaluate the scientific basis for estimating emissions of various air pollutants (including PM10, PM 2.5, hydrogen sulfide, ammonia, odorous substances, VOCs, methane, and nitrous oxide); relevant characteristics of agricultural animal industries that may affect emissions; and mitigation techniques and best management practices for reducing emissions. The committee will evaluate the influence of animal life stages, weather patterns, and other biologic and physical factors on the variability of emissions from concentrated animal feeding production systems. It will also consider approaches and information needed to evaluate local and long-range health and ecologic effects of such emissions. The committee will consider relevant literature and data, including reports compiled by the EPA and USDA on air quality research, air emissions, and air quality impacts of livestock waste. The committee will identify critical research needs over the next five years for improving approaches for estimating emissions and potential emission mitigation techniques.

Findings

Setting Priorities

Finding 1. Much confusion exists about the use of the term “animal unit”because EPA and USDA define animal unit differently.

Finding 2. Air emissions from animal feeding operations are of varying concern at different spatial scales.

Finding 3. Measurement protocols, control strategies and management techniques must be emission and scale specific.

Findings

Estimating Air Emissions

Finding 4. There is a general paucity of credible scientific information on the effects of mitigation technology on concentrations, rates, and fates of air emissions from AFOs. However, the implementation of technically and economically feasible management practices (e.g., manure incorporation into soil) designed to decrease emissions should not be delayed.

Finding 5. Standardized methodology for odor measurement have not been adopted in the United States.

Finding 7. Scientifically sound and practical protocols for measuring air concentrations, emission rates, and fates are needed for the various elements (nitrogen, carbon, sulfur), compounds (e.g., NH_3, CH_4, H_2S), and particulate matter.

Findings

Systems Approach

Finding 8. **Estimating air emissions from AFOs by multiplying the number of animal units by existing emission factors is not appropriate for most substances.**

Finding 9. **Use of process-based modeling will help provide scientifically sound estimates of air emissions from AFOs for use in regulatory and management programs.**

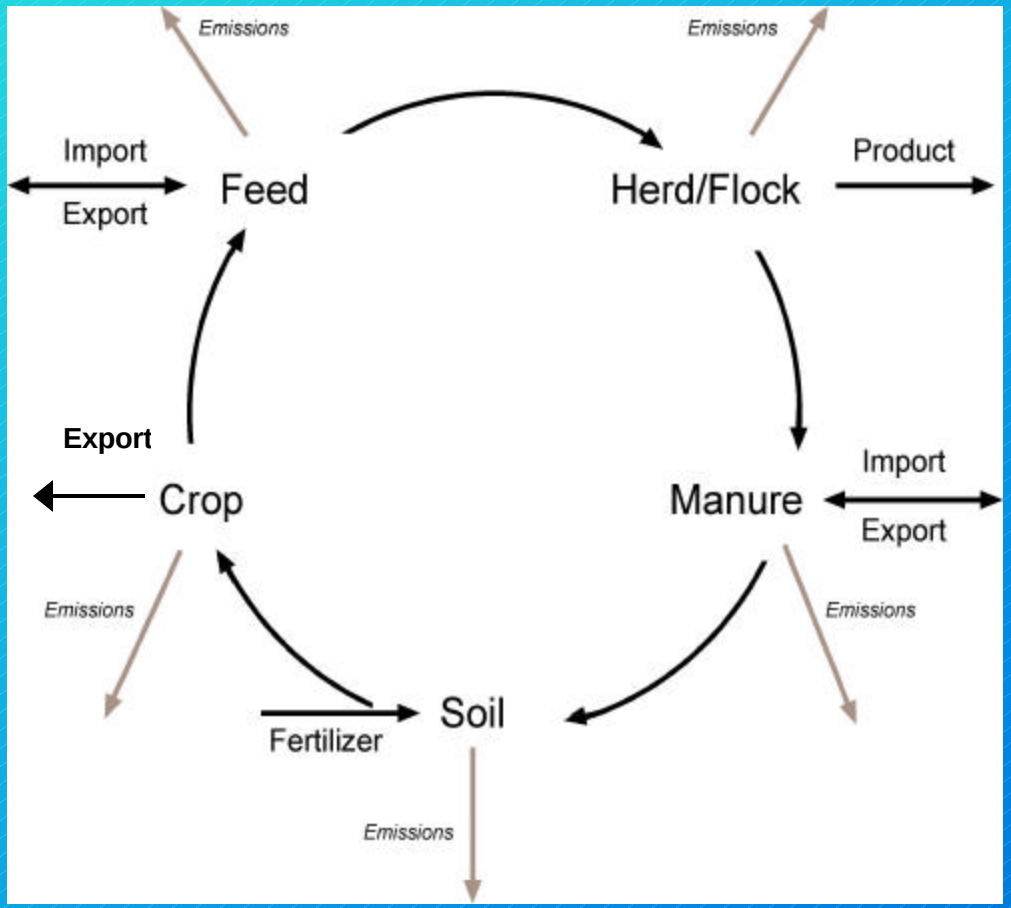
Findings

Systems Approach

Finding 10. A systems approach, which integrates animal and crop production systems both on and off (imported feeds and exported manure) the AFO, is necessary to evaluate air emissions from the total animal production system.

Finding 11. Nitrogen emissions from AFOs and total animal production systems are substantial and can be quantified and documented on an annual basis. Measurements and estimates of individual N species components (i.e., NH_3, molecular nitrogen [N_2], N_2O, and nitric oxide [NO]) should be made in the context of total N losses

Process-Based Model



Findings

Research Needs

Finding 6. The complexities of various kinds of air emissions and the temporal and spatial scales of their distribution make direct measurement at the individual farm level impractical other than in a research setting. Research into the application of advanced three-dimensional modeling techniques accounting for transport over complex terrain under thermodynamically stable and unstable planetary boundary layer (PBL) conditions offers good possibilities for improving emissions estimates from AFOs.

Finding 11. Nitrogen emissions from AFOs and total animal production systems are substantial and can be quantified and documented on an annual basis. Measurements and estimates of individual N species components (i.e., NH_3, molecular nitrogen [N_2], N_2O, and nitric oxide [NO]) should be made in the context of total N losses

Findings

Research Needs (continued)

Finding 12. **USDA and EPA have not devoted the necessary financial or technical resources to estimate air emissions from AFOs and develop mitigation technologies. Scientific knowledge needed to guide regulatory and management actions requires close cooperation between the major federal agencies (EPA, USDA), the states, industry and environmental interests, and the research community, including universities.**

Finding 13. **Setting priorities for both short- and long-term research on estimating air emission rates, concentrations, and dispersion requires weighing the potential severity of adverse impacts, the extent of current scientific knowledge about them, and the potential for advancing scientific knowledge, the potential for developing successful mitigation and control strategies.**

Animal feeding operations system (animals plus associated cropland).